

Tutorial On RISC V

Simulator

- I'll be using Rars, also see description of system calls here. It as well have a nice companion documentation to understand more about risc v, it is expected that one has given it a read.
- Can try Venus, Github repo: <https://github.com/kvakil/venus>. Note that for system calls, their argument register is different, see this.
- Can use spike, installed when using `riscv-gnu-toolchain`. Note it was as well required to install pk. System calls are different than RARS, basically it follows linux system calls. Can see these system calls here1, and here2. And linux system calls here, note system calls of interest can be concisely seen here.

So to compile and run the program, do: (Don't know if this is the intended way but after a lot of trial and error, I found this)

```
riscv64-unknown-elf-as -o filename.o filename.s
riscv64-unknown-elf-ld -o filename filename.o
spike pk filename
```

Examples

- Note that dont use `$reg`, instead simply use `reg`.
- Always have two sections, one for data and another for text.
- During `ecall` all registers besides the output are guaranteed not to change.

Hello Word

```
.data

msg: .string "hello world"

.text
```

```

start:
    li a7, 4
    la a0, msg
    ecalls
    li a7, 10
    ecalls

```

To get the same code working using spike.

```

.globl _start # We must need to give _start, .globl helps to see it outside this file
.data # Tell the assembler we are defining data not code
str: # Label this position in memory so it can be referred to in our code
    .string "Hello World!\n" # Copy the string "Hello World!\n" into memory

.text # Tell the assembler that we are writing code (text) now
_start: # Make a label to say where our program should start from

    li a0, 1 # li means to Load Immediate and we want to load the value 1 into register a0
    la a1, str # la is similar to li, but works for loading addresses
    li a2, 13 # like the first line, but with 13. This is the final argument to the system call
    li a7, 64 # a7 is what determines which system call we are calling and we what to call with
    ecalls # actually issue the call

    li a0, 0 # The exit code we will be returning is 0
    li a7, 93 # Again we need to indicate what system call we are making and this time we are making
    ecalls

```

Fibonacci

```

.globl _start

.data
    msg1: .string "Please enter a number: "
    msg2: .string "The "
    msg3: .string " fibonacci number is: "

.text

_start:
    # Initial 2 fibs
    li t0, 0
    li t1, 1
    # prints msg1
    la a0, msg1
    li a7, 4
    ecalls

```

```

# reads an int and moves it to register t3
li a7, 5
ecall
mv t3, a0
# prints a newline character
li a7, 11
li a0, '\n'
ecall
# prints msg2
la a0, msg2
li a7, 4
ecall
# prints the int value in t3
mv a0, t3
li a7, 1
ecall
# fibonnaci program
fib:
    beq t3, zero, finish
    add t2, t1, t0
    mv t0, t1
    mv t1, t2
    addi t3, t3, -1
    j fib
finish:
    # prints msg3
    la a0, msg3
    li a7, 4
    ecall
    # prints the result in t0
    mv a0, t0
    li a7, 1
    ecall
    # prints a newline
    li a0, '\n'
    li a7, 11
    ecall
    # ends the program with status code 0
    li a7, 10
    ecall

```

Saving callee save registers

.data

```

    bef: .string "Before modification, value is: "
    dur: .string "\nInside function, value is: "
    aft: .string "\nAfter function call, value is: "

.text

main:
    addi s0, zero, 1
    # Print bef
    la a0, bef
    li a7, 4
    ecall
    # Print int
    li a7, 1
    mv a0, s0
    ecall
    jal increment
    # Print aft
    la a0, aft
    li a7, 4
    ecall
    # Print int
    li a7, 1
    mv a0, s0
    ecall
    # Exit
    li a7, 10
    ecall

increment:
    addi sp, sp, -4
    sw s0, 0(sp) # '0' denotes the offset
    addi s0, s0, 1
    # Print string
    la a0, dur
    li a7, 4
    ecall
    # Print the incremented integer
    mv a0, s0
    li a7, 1
    ecall
    lw s0, 0(sp)
    addi sp, sp, 4
    jr ra

```

String comparison

```
.data

    str1: .string "sourabh"
    str2: .string "saurabh"
    str3: .string "sourabz"
    str4: .string "sourabh"

.text

main:
    la a0, str1
    la a1, str2
    jal strcmp
    # Print int
    li a7, 1
    ecall
    la a0, str1
    la a1, str3
    jal strcmp
    # Print int
    li a7, 1
    ecall
    la a0, str1
    la a1, str4
    jal strcmp
    # Print int
    li a7, 1
    ecall
    # Exit
    li a7, 10
    ecall

strcmp:
strcmptest:
    lb a2 (a0)
    lb a3 (a1)
    beq a2, zero, strcmpend
    beq a3, zero, strcmpend
    bgt a2, a3  strcmpgreat
    blt a2, a3  strcmpless
    addi a0, a0, 1
    addi a1, a1, 1
    j strcmptest
```

```
strcmprgreat:
    li a0, 1
    jr ra
strcmprless:
    li a0, -1
    jr ra
strcmprpend:
    bne a2 zero strcmprgreat
    bne a3 zero strcmprless
    li a0, 0
    jr ra
```